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ABSTRACT

Effectiveness of Pharmacist Delivered Medication Reconciliation Interventions on Hospital Readmission Rates: A Literature Review

By

Charles S. Lee

July 27, 2017

Introduction: Unnecessary hospital admissions and readmissions can expose individuals to potential risks such as unnecessary treatment and can be costly to both hospitals and to patients. Approximately one in every five hospital discharges of Medicare patients is readmitted to the hospital within 30 days of discharge and the annual cost of unplanned hospital readmissions is about \$17.4 billion. Under the ACA provision, the Centers for Medicare & Medicaid Services (CMS) reduces payments to hospitals that have excess 30-day readmission rates. Therefore, hospitals are particularly focused on reducing hospital readmission rates. Pharmacist-delivered interventions may be one strategy that hospitals can implement which may reduce readmission rates.

Purpose: Although medication reconciliation is recognized as one of the most effective strategies for reducing hospital readmission, the evidence regarding the effectiveness of pharmacist-delivered medication reconciliation interventions, specifically, on hospital readmission rates is mixed. The aim of this literature review is to investigate available evidence regarding the clinical and financial impact of pharmacist-delivered medication reconciliation interventions across a variety of interventions and to suggest next steps for future research, practice and policies based on this evidence.

Methods: To find available data for pharmacist-delivered medication reconciliation on hospital readmission, four electronic databases were used for selecting articles: ProQuest Central, Pubmed, Medline, CINAHL, Wiley Online library were used.

During the database search, the following main keywords used were 'medication reconciliation,' 'transition of care,' 'pharmacy,' 'adverse drug event,' and 'patient readmission.' Searches were limited to articles published in English.

Results: Several studies suggest that the impact of pharmacist-led medication reviews on hospital readmission rates is not clear. Some evidence does suggest, however, that pharmacist-led medication reconciliation programs does have a significant impact on improving drug-related readmissions, particularly among low health literacy patients, and may facilitate cost containment. More research is needed to address confounding factors and the role of pharmacy teams such as pharmacy interns or pharmacy technicians.

Effectiveness of Pharmacist Delivered Medication Reconciliation Interventions on Hospital Readmission Rates: A Literature Review

by

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Pharm. D. St John's University

A Capstone Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
Requirements for the Degree

MASTER OF PUBLIC HEALTH

ATLANTA, GEORGIA
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APPROVAL PAGE

**Effectiveness of Pharmacist Delivered Medication Reconciliation Interventions
on Hospital Readmission Rates: A Literature Review**

by

Charles S. Lee

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Author's Statement Page

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____Charles Lee____
Signature of Author

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Chapter 1Introduction

1.1 Background

Reducing avoidable hospital admissions and readmissions are important quality metrics of the healthcare system. Unnecessary hospital admissions and readmissions can expose individuals to potential risks such as unnecessary treatment and can add costs to both hospital and to patients. Avoidable hospital admissions and readmissions also significantly contribute to rising cost of the healthcare system in the United States. Approximately one in every five hospital discharges of Medicare patients is readmitted to the hospital within 30 days of discharge and the annual cost of unplanned hospital readmissions is about \$17.4 billion (Jencks, Williams & Coleman, 2009). Some readmissions are unavoidable, but some are the result of poor quality of care, lack of discharge planning and adequate transition of care, inadequate coordination of care, or lack or limited patient access to post-hospital care (such as rehabilitation facilities). Goldfield, McCullough & Hughes (2008) state that across all insured patients, around 11 percent of hospital readmissions are preventable.

According to executive review by Jweinat, (2010) sociodemographic factors such as age, race, and type of insurance and severity of illness pose a high risk of hospital readmission. Increasing age has been showing consistent increase of patients' hospital readmission and likelihood of readmission for African American and Hispanic patients is higher than that for Caucasians and other racial groups. Also, Medicaid-insured patients were more likely to be readmitted than patients with commercial insurance. Another study conducted by Silverstein et al. (2008) demonstrated that the following factors increased

relative risk of 30-day readmission: African American, male, and increasing of age older than or equal to 70. Lavernia, Villa & Jacobelli, (2013) suggests that these factors are possibly related to readmissions due to racial discrepancy and socioeconomic status of patients. Racial discrepancy is the difference between racial groups. Being African American and Hispanic race increase risk of having low health literacy and lower socioeconomic status also increase risk of having low health literacy (Vernon et al. 2007) Then, Bailey et al. (2015) found people with lower health literacy has 23% increased risk of 30-day hospital readmission rate. .

Jweinat (2010) states the presence of comorbidity increases the risk for readmission by 1.3 to 6.9 percent, compared with having no comorbidities. The comorbidities were conditions affecting major organs and systemic conditions. Research by Graham et al. (2015) found interesting trends of timing in readmission. Patients discharged between 8 a.m. and 1 p.m. were less likely to be readmitted to hospital possibly due to presence of family caregivers helping them to receive information and arranging any necessary scheduling.

In order to minimize unnecessary spending of hospital and open opportunities for billions of dollars of saving within a hospital, the Affordable Care Act (ACA) was created to decrease cost, increase access to health care, and improve the quality of health care. Under the ACA provision, the Centers for Medicare & Medicaid Services (CMS) reduces payments to hospitals that have excess 30-day readmission rates written in Section 3025 (U.S. Congress 2010). The ultimate goal of Section 3025 is to reduce preventable hospital readmissions, prevent hospitalizations, and improve health outcomes. CMS mainly targets health conditions using hospital readmission rate as key measurement. As of 2016, CMS provided a list of covered conditions to include 30-day readmissions for Heart attack, Heart failure (HF),

Pneumonia, Chronic obstructive pulmonary disease (COPD) and Elective total hip and total knee replacements. CMS are including new conditions as needed and in order to avoid penalties, hospitals must find a way for better transition of care, coordination of care, and on the care upon patient discharge among these conditions.

Focusing on reducing hospital readmission rates provides both opportunities and expectations for pharmacists. Clinical pharmacists are expected to use their expertise of medication knowledge in several ways to deal with readmission problems. One of the main roles of pharmacists is conducting medication reconciliation, although such procedure is not always available for everyone, depending on the hospitals. Medication reconciliation is defined as “a process of identifying the most accurate list of all medications a patient is taking — including name, dosage, frequency, and route — and comparing the patient’s current list of medications against the physician’s admission, transfer, and/or discharge orders” (Institute for Healthcare Improvement, [IHI], n.d.). Medication reconciliation interventions by pharmacists are showing valuable impact on hospital readmission rate. Polinski et al. (2016) conducted a study that used hospital-based medication reconciliation program which cut readmission rates by 50%, lowering overall risk of hospital readmission from 22% to 11%.

In addition to the risk factors that have been discussed before, there is one other important factor that has been showing impact on hospital readmission rate, which is Adverse Drug Event (ADE). As soon as patients are admitted to a hospital, unintended therapeutic changes are common, and suboptimal communication during the transition may result in medication errors, which could lead to potential harm (Mekonnen, McLachlan & Brien, 2016). According to the Brown (2013), 23.4 percent of readmission in elderly patients and 4.5

percent of all-cause readmissions are associated with ADEs. Poor communication of medical information at transitional times in care is responsible for as many as 50% of all medication errors in the hospital and up to 20% of ADEs (Poole, Chainakul, Pearson & Graham 2006).

Considering the distinct knowledge and skills that pharmacists possess relating to medication therapy, they should be directly involved in the medication reconciliation process and their involvement may reduce adverse outcomes (Super, Phillips, Coffey & Patterson, 2014). Preventable ADEs occur frequently at transitions in care. According to McLachlan, Yi, Ling & Jardine, (2014) and Dalleur, Beeler, Schnipper, & Donze, (2017), the ADEs related hospital readmissions were 13.1% and 19.3%, respectively.

At discharge, pharmacists can conduct patient-centered medication reconciliation, in order to confirm that there is no complication between previous medications and medications that patients will take upon discharge. Pharmacists also educate patients to let them know what and how they should take the medications, provide adherence counseling, communicate with patients' primary care provider (PCP) to minimize medication errors, and contact patients to listen to any problems such as side effects and any other concerns that affect adherence (Brown, 2013). Pharmacists are uniquely positioned to prevent ADEs, and involving pharmacists on patient education upon discharge or at admission can influence outcomes and reduce readmissions (Anderegg et al., 2014).

1.2 Purpose of capstone

Although medication reconciliation is recognized as one of the most effective strategies for reducing hospital readmission, the effectiveness of pharmacist-delivered

medication reconciliation on hospital readmission rates is not yet concrete. A recent study by Mueller et al. (2012) supports that pharmacist-led medication has better outcomes than other medication reconciliation interventions led by a nurse or physician. However, it is difficult to assess what types of interventions actually reduce readmissions as pharmacists are involved in a variety of settings, and there are mixed results in regards to pharmacist-involved medication reconciliation. The aim of this literature review is to investigate available evidence regarding pharmacist-delivered medication reconciliation interventions on hospital readmission rates across a variety of interventions to evaluate clinical and financial impact of pharmacist effectiveness.

Chapter 2 Method

To find available data for pharmacist-delivered medication reconciliation on hospital readmission, four electronic databases were used for selecting articles: ProQuest Central, Pubmed, Medline, CINAHL, Wiley Online library were used. During the database search, the following main keywords used were 'medication reconciliation,' 'transition of care,' 'pharmacy,' 'adverse drug event,' and 'patient readmission.' Searches were limited to articles published in English

Chapter 3 Review of Literature

3.1. Study characteristics

Of the 15 identified studies, there were 8 studies which reported a positive impact of pharmacist-administered medication reconciliation interventions on readmission rates, 1 study which reported mixed results and 5 studies which reported null results. Table 1 shows overview of identified studies.

3.2 Literature Review

A study conducted by Sebaaly et al. (2015) focused on investigating patient safety and cost associated with medication errors by delivering pharmacist-led medication reconciliation upon patients discharge. The prospective, cross sectional pilot study was conducted. Patients who were 18 years of age or older who were discharged from Monday through Friday for a 7-week period from September to October 2013 were included. A total of 77 patients were contacted, and ten patients were not able to have discharge verification, thus the remaining 67 patients were assessed. The workflow of the medication review process for this study started with discharge orders. As soon as discharge orders were written, nurses paged pharmacists, then pharmacists reviewed medication and contacted physicians with any medication errors. The time to complete the entire review by the pharmacist was recorded. Each condition was recorded in a severity scale, which was Lethal (\$3000/error), Serious (\$2000/error), Significant (\$500/error), Minor (\$50/error), and No Harm to Patient. The cost avoidance associated with each error was determined using methods described by Nesbit et al (2000). Then the 30-day readmission rate was also evaluated to compare these outcomes with

a control group which was from a historical cohort of patients admitted and discharged from the same units from July and August 2013. During the 7-week study period, pharmacists performed 67 discharge medication reviews and identified 84 errors. The price of cost saving varied according to the severity of ADE identified. In the end, the 30- day readmission rate in the study cohort was 18%, compared with 20% in the control group. The result number was numerically low, but it was not statistically significant. Based on the severity scale and pharmacist salaries, the intervention resulted in \$42,300 in cost avoidance (Sebaaly et al., 2015).

Anderegg et al. (2014) conducted an observational pre-post analysis study at an academic medical center. The 30-day readmission rate was compared during three month periods before and after implementation of a restructured pharmacy practice model. The model includes medication reconciliation at transitions of care for every patient and discharge education for a high risk subgroup. There was a pharmacist to patient ratio of 1:30 on acute care floors and 1:18 on critical care units. The high risk subgroup was classified as those patients using any of Anticoagulation congestive heart failure, COPD, and Pneumonia medication. A total of 3,316 patients were included in the study. Of those participants, pharmacy teams completed medication reconciliation on 95.8 percent of cases at admission and 69.7 percent of cases at discharge. Contacting all patients was not possible due to the pharmacy team schedule and early discharges of patients. Discharge education was provided to 73.5 percent of high risk patients. There were 325 high risk patients in pre-implementation and 358 at post-implementation. No significant difference was present among the non- high risk subgroup, but there was a significant reduction in the high-risk subgroup. In the high-risk subgroup, ($p= 0.042$); cost projection indicated that this reduction could yield annual district

cost savings of more than \$780,000 (Anderegget al., 2014).

A pilot study conducted by Guandi et al. (2015) showed benefits of developing and implementing a pharmacy-led transitions of-care program to reduce the risk of readmission and increase satisfaction for HF patients. A medication discrepancy, the difference of medication that a patient was taking before admission and taking as ordered medication, was common at St.Peter Hospital. Also, polypharmacy and inappropriate medication use occurred during transitions caused ADEs of HF patients. Therefore, the site started implementing pharmacy-led medication reconciliation which included the pharmacist, resident, and student from 2011. Admission and discharge medication review was conducted as well as counseling for the patient with HF. HF patients were categorized into scores from 0 to 8, with 0-2 indicating a low risk for readmission, 3-5 indicating a moderate risk, and 6-8 indicating a high risk. The category model was previously developed by Kansagara et al. (2011). If a patient's readmission risk was moderate or high, a score of 3 or greater, patients were qualified for a new prescription. The program resulted in reduction of a 30-day readmission from 2011 to 2013. The readmission rate of patient with moderate to high risk patient was lower 11.9 percent (5 of 42 patients) versus 15.3 percent (24 of 155 patients). Then, all HF patients' 30-day readmission rate improved from 17 percent (82 of 471 admissions) to 15 percent (76 of 498 admissions). For each avoided readmission, there was an associated decrease of \$5,652 in variable costs (Guandi et al., 2015).

Arnold, Buys & Fullas (2015) conducted a prospective study to examine whether pharmacist-led hospital follow-up for the patient versus physician alone would show a difference with respect to increased quality and improved care coordination when

pharmacists worked in conjunction with physicians. Previous year's readmission data for high risk patients (older than 50 years old and taking more than 5 medications) who received only physician visits were collected for comparison with those who were jointly visited by pharmacists and physicians. A total of 98 patients received a pharmacist intervention in conjunction with hospital follow-up visits at physicians' offices. Pharmacists formed a team and performed medication reconciliations and comprehensive chart reviews assessing accuracy of medication history, as well as monitoring of medication therapy and evidence-based chronic disease state management. Then, those interventions were provided to the patients' physicians. Patients seen by both pharmacists and physicians who were readmitted to a hospital within 30 days of discharge was 9.2%, whereas 19.4% was readmitted during the previous year of only physicians' follow-up. The difference was statistically significant ($p = 0.023$) and suggested that pharmacist intervention reduced overall readmission rate in high-risk patients (Arnold, Buys & Fullas, 2015). Another study, which was a prospective, historical control study at Yale-New Haven Hospital, conducted a six-month period of pharmacy-facilitated medication reconciliation to a general medicine unit with the highest 30-day readmission rate (Zemaitis, Morris, Cabie, Abdelghany, & Lee, 2016). Pharmacy technicians compiled the medication reconciliation information and counseling and discharge phone calls were done with the pharmacist at the patient's primary team. Medication reconciliation information was reviewed by the pharmacist before discharge. Then the preceding 6 months with intervention period was compared and 465 patient received pharmacy intervention and the outcomes showed a 27 percent reduction in readmission during the intervention period. Meanwhile, educated pharmacy technicians showed similar benefits when compared with pharmacists. The pharmacists guided pharmacy technicians until they were able to perform medication reconciliation, counseling, and give phone calls to

patients. Then, pharmacist made sure everything was correct when pharmacy technicians had completed the reconciliation process (Zemaitis, Morris, Cabie, Abdelghany, & Lee, 2016).

Pal, Babbott& Wilkinson (2013) conducted a prospective, nonrandomized cohort study which examined the impact of pharmacist-delivered medication reconciliation on 30 day readmission rates; they were also interested in understanding the role of polypharmacy in the effectiveness of the intervention. Polypharmacy was categorized as a patient taking more than 10 drugs. Pharmacists provided medication counseling for each patient, and problem pharmacists used teach-back methods to confirm patient understanding specifically for problem medication. Problem medications were medications that have high possibilities of drug related problems if consumed wrong, such as insulin and warfarin. In addition to individual counseling, pharmacists verified prior patients' medication and over the counter medication. A total of 729 patients were discharged, and those patients receiving pharmacy discharge review (n=537) were compared to those without pharmacy discharge review (n=192).The 30-day readmission rate was 16.8 percent among the pharmacy review group vs 26.0 percent among the no-review group; this difference was statistically significant ($p=.006$). There was a progressive increase in 30-day readmission rates as the number of medications increased (Pal, Babbott& Wilkinson, 2013).

Paquin et al. (2015) evaluated the effect of Pharmacological Intervention in Late Life (PILL) service that provided pharmacist telephone follow-up after discharge of elderly from the hospital. Telephone follow-up included medication reconciliation within 5 days after discharge. This study was a retrospective secondary data analysis from 2010 to 2012 that

included 501 high risk participants (older than 65 who was ordered for medication of acetyl cholinesterase inhibitor [donepezil, glantamin, rivastigmine] or N-methyl-D-aspartate antagonist [memantine] or inpatient who had risk of developing delirium, as indicated by cognitive impairment, sensory impairment, or dehydration). Of the participants, 98% were male. The average number of discharge medications was 14.8 ± 5.7 with 2.8 ± 2.2 medication changes and 1.4 ± 1.8 discrepancies between medication order and every additional 5 minutes of pharmacist-led medication reconciliation on telephone calls was associated with a 15% reduction in 60-day readmission which also had statistical significance. Li, et al. (2016) conducted a prospective pilot study that included adult patients who were discharged from the pilot unit from January 5 to January 30, 2015. 131 patients were screened and 94 patients were included because patients were expired during hospitalization or transferred to another unit or facilities. Pilot data were collected prospectively via electronic chart review and historical data for patients retrieved using the same inclusion and exclusion criteria. Primary outcome of 30-day readmission rate was 12.8% in the pilot group vs. 18.8% of participants in historical control, but there was no statistical significance ($p = 0.26$). Katelin et al. (2015) conducted a pilot study with a historical control. Patients were included if they had pneumonia and any of the following high-risk criteria: admission within 6 months, at least 5 scheduled home medications, COPD, or HF. A retrospective chart review was conducted to compile the historical control group that received usual care. The intervention included medication reconciliation, therapeutic recommendation, and follow-up phone calls by the pharmacists. There was a trend toward a reduced 30-day readmission rate in the intervention group ($n = 43$) compared to usual care ($n = 65$) (27.9% vs. 40.0%; 95% CI, 0.3965-1.2278; $p = 0.2119$).

Tedesco et al. (2016) conducted a pilot study to evaluate the effect transition of care follow-up and counseling performed by a pharmacist at physicians' practices on patients' 30 day hospital readmissions. The study used two locations, one in Pittsburgh and one in Uniontown. The Pittsburgh site was selected for the intervention because of academic partnership with a school of pharmacy and the presence of the primary pharmacist researcher within the office. The Uniontown site was selected as the control site because of its similarity to the Pittsburgh site in terms of population size, number of physicians, and patient demographics, such as age, gender and insurance status. A pharmacy team, consisting of 2 pharmacists and at least two rotation student pharmacists in the intervention group, contacted patients via telephone within 3 business days of their hospital discharge. Medication reconciliation and hospital's instructions with regard to discharge counseling were given and the pharmacy team ensured that patients understood how to take their medications, identified any barriers to treatment, and answered questions. Then, all patients were advised to schedule for an appointment with their physicians within 7 days (and within 14 days when schedule did not allow). Once the schedule was set, the patient was then asked to report one and a half hour prior to their appointment for a face-to-face meeting with the pharmacist. Intervention group had total 34 patients that had 18 patients who contacted a pharmacist only via telephone, and 16 with both phone and face-to-face appointments. Then the control group had 43 patients who didn't interact with the pharmacy team. The readmission rates for the control and intervention groups were 26.7 percent and 14.7 percent, respectively. However, the difference was not statistically significant ($p = .27$). However, the statistically significant difference ($p=.026$) on readmission rates of patients who interacted with pharmacist face-to-face in the intervention group was (0 percent) versus those in the control group with no pharmacist interaction (26.7 percent). Of the 18 patients who interacted with the pharmacist

via phone only, 5 were readmitted to the hospital within 30 days, while none of the 16 patients who interacted with the pharmacist face-to-face were readmitted within the 30-day window. This result was marginally significant ($p = .05$).

Farris et al. (2014) conducted an RCT of 945 participants to determine if a pharmacist case manager providing a faxed discharge medication care plan from a tertiary care institution to primary care could lower ADEs, re-hospitalization, and emergency department visits. A minimal intervention group and an enhanced intervention group were compared from 2007 to 2012. The minimal group received medication reconciliation, patient education, discharge medication list, and the enhanced group faxed medication care plans to their community physicians and conducted pharmacy telephone calls 3-5 days post-discharge. There were no statistically significant differences in 30-day readmission rate or ADEs. The pharmacy case manager did not affect the result as both groups were receiving a high quality of care. Other RCT conducted by Briggs et al. (2015) compared the intervention to current practice. Intervention was that a single pharmacist reviewed the medications of older for patients at the single site. Patients were included in the study if they lived at home and reported taking more than five medications, and were excluded if lived in a residential aged care. The odds of admission decreased with the intervention (odds ratio [OR]=0.68, 95% CI: 0.53-0.87; $p = 0.002$).

A RCT conducted by Bell et al. (2016) was designed to determine the effect of the Pharmacist Intervention for Low Literacy in Cardiovascular Disease (PILL-CVD) on unplanned health care utilization, including hospital readmission or emergency room (ER) visit, following discharge. The study was a randomized controlled trial with concealed

allocation, and blinded outcomes assessors at two academic medical centers: Vanderbilt University Hospital (VUH) and Brigham and Women's Hospital (BWH) between May 2008 and September 2009. Participants were randomly assigned to receive usual care or intervention in a 1-to1 ratio. The intervention included pharmacist-led medication reconciliation, inpatient counseling, low-literacy adherence aids and individualized telephone follow-up after discharge. Health literacy was defined as the degree to which individuals have the capacity to understand basic health information and services needed to make appropriate health decisions. Patients aged 18 and older who were hospitalized for acute coronary syndromes (ACS) and/or acute decompensated heart failure (ADHF) were recruited and the disease was determined by a physician. Test of Functional Health Literacy in Adults were administered to measure health literacy. Scores ranged from 0 to 36, with higher scores indicating higher health literacy. Primary outcome was time for first unplanned health care event and secondary outcomes were readmission or ER visit within 30 days. Usual care in each hospital included the nurses, pharmacists, and physicians involved in the patients' care with medication reconciliation and counseling. Post-discharge follow-up calls were not routinely performed in usual care group. Then intervention group had specific component in each intervention such as pharmacists-reconciled preadmission medications, discharge medications with the patient, providing tailored counseling that assesses patient understanding of the medication regimen, and barriers to medication adherence. Then at discharge, the pharmacist provided additional counseling with teach-back technique and lastly, within four days of discharge, study coordinators contacted patients for any regimen confusion, symptoms, non-adherence or side-effects. If issues were raised, the coordinator contacted pharmacists to help the patients. A sample size of 862 patients calculated based on the primary outcome of the study design for adequate statistical power. However, seven

intervention patients and four usual-care patients died during hospitalization or withdrew consent. Thus, 851 patients were enrolled of which 423 were intervention (197 VUH and 226 BWH) and 428 usual-care (200 VUH and 228 BWH). The primary outcome did not show a statistically significant difference, adjusted HR (risk of outcome over 30 days with intervention, using usual-care group as reference) =1.04 (95 percent CI 0.78 – 1.39). HR adjustment included age, sex, race, marital status, insurance type, study site, presence of PCP, cognitive status, diagnosis, length of stay, number of discharge medications, presence of prior hospitalizations and health literacy. Secondary outcomes also showed no statistical significance between intervention and control groups, adjusted HR for ER visits was 1.03 (95 percent CI 0.76 – 1.39). Meanwhile, there was a significant interaction of treatment effect with patients' health literacy level. The intervention reduced early, unplanned health care utilization among patients with inadequate health literacy (adjusted HR = 0.41, 95 percent CI 0.17-1.00 p = 0.03), but not among patient with adequate health literacy (adjusted HR = 1.07, 95 percent CI 0.77 – 1.48). ER visits among those intervention patients with inadequate health literacy was (adjusted HR= 0.29, 95 percent CI 0.11-0.78 p=0.01)

A systematic review by Renaudin et al. (2016) identified studies from Medline and Cochrane Library databases. The inclusion criteria for studies were randomized controlled trial (RCT), pharmacist-led medication review versus usual care and emergency department (ED) visits at different time points. Primary outcomes were all-cause readmissions, all-cause ED visits, and secondary outcomes were drug-related readmissions and quality of life. Out of 19 RCT studies, the readmission rates did not differ between pharmacist care and usual care group (RR = 0.97, 95 percent CI; 1.05, p=0.470). The secondary outcomes did not differ between the groups except for drug-related readmissions, which were lower in the pharmacy-

led group (RR= 0.25, 95 percent CI 0.14; 0.45, $p < 0.001$), and all-cause ED visits (RR=0.70, 95 percent CI 0.59; 0.85 $p=0.001$).

Parajuli et al. (2017) conducted a systematic review that examined the role of the pharmacists for improving self-care in HF. Similar to other chronic diseases, HF requires patients to conduct self-care to minimize progression of disease. It has multiple comorbidities as well as unusually high hospital readmissions. The review searched different databases: Medline, PubMed, Scopus, EBSCO and Web of Science from 2013 through to October 2016. Applied keywords for searching were “heart failure” OR “left ventricular dysfunction” OR “cardiomyopathy” OR “left ventricular ejection fraction” OR “LV dysfunction” OR “systolic dysfunction” OR “diastolic dysfunction” OR “cardiac failure” OR “preserved ejection fraction” OR “HFpEF” OR “reduced ejection fraction” OR “HFrEF” AND pharmacist OR “pharmaceutical care” OR “pharmaceutical service” AND “self-care” OR “self-management” OR “self-monitoring” OR “self-efficacy”. Out of 82 articles defined, 49 articles were identified after excluding duplicates. After further review of title and abstract, 14 articles were remained to review. Although studies had significant heterogeneity such as having different models of care, patient populations and study designs, pharmacists involvement in HF patients have improved drug adherence, decreased 30-day readmission, increased patient satisfaction and increased patients’ in HF knowledge. However, some studies have shown mixed results for improvement in readmission rates possibly due to heterogeneity of the studies and different lengths of follow up. Meanwhile it was clear that pharmacist improved medication management improved patients’ self-care behaviors such as drug adherence.

Chapter 4 Strength & Limitations

4.1 Strengths

Several studies (Pal, Babbott & Wilkinson, 2013; Zemaitis, Morris, Cabie, Abdelghany, & Lee, 2016; Arnold, Buys & Fullas, 2015; Sebaaly et al., 2015) used a prospective study design which was a strength because, researchers began collecting data at baseline and thus could observe the data as time goes. These studies were able to measure incidence, prevalence, and multiple outcomes.

Two studies (Parajuli et al. 2017; Renaudin et al. 2016) have done a systematic review. These reviews have reviewed current RCT studies, which are reliable as they are evidence-based. Guandi et al., (2015) and observational pre-post analysis by Anderegg, et al., (2014) had strength as the study could suggest that outcome was impacted by an intervention. The studies conducted by (Farris et al., 2014; Bell et al., 2016; Briggs et al., 2015) employed a RCT design, which increases the ability for researchers to evaluate the influence of the various interventions on outcomes of interest.

4.2 Limitations

Several studies were done at a single facility with unique population (Pal, A., Babbott, S., & Wilkinson, S. T. 2013; Anderegg et al., 2014; Guandi et al., 2015; Paquin et al. 2015) and thus the results of these studies may not be generalizable to other people or situation.

Inadequate sample size is another limitation in several studies (Tedesco, G. W., Mcconaha, J. L., Skomo, M. L., & Higginbotham, S. K. 2016). It limits the study's power and makes conclusions difficult to draw. Systematic reviews (Parajuli et al., 2017 Renaudin et al. 2016) had its limitation on target population and medications reviewed in the studies differed too much to have external validities. Since the RCT by Briggs et al. (2015) involved only one pharmacist who is an experienced pharmacist, similar results may not be seen in other studies. A large portion of RCT studies included a small number of subjects which raises concern on the likelihood that it may reduce a statistically significant result, a true effect. There would be a possibility that non-English publications on journals would have statistically significant findings as the searches were limited to English. Also, there were common limitations of the studies on confounding factors such as patients' ability to obtain needed medication after discharge, patient readiness for discharge, and readmissions caused by reasons unrelated. These factors may have affected readmission rate, even though they were unaccounted.

Several pilot design studies (Tedesco, G. W., Mcconaha, J. L., Skomo, M. L., & Higginbotham, S. K. 2016; Sebaaly et al. 2015; Paquin et al. 2015; Guandi et al., 2015) reduced number of samples and duration of study, which possibly leading to type II error particularly on patients' readmission rate. Failing to reject false null hypothesis would be the difference in readmission rate in this case as more patients were enrolled which lowered readmission rate. Also, checking severity scale on patients' condition (Sebaaly et al., 2015 Bell et al. 2016) may be biased as each pharmacist could rate a condition differently.

Chapter 5 Recommendations for Future Research

Of the studies that have been reviewed, the results from studies which have evaluated the effectiveness of involving pharmacists in patient care to reduce 30-day hospital readmission are mixed. One of the important consequence of reducing hospital readmission is lowering cost for the healthcare system and benefit the public health overall. As Farris et al., (2014) suggests doing more is not a necessary step to lower hospital readmission rate, finding a cost-effective use of pharmacist-led medication reconciliation is essential. Since there is evidence that educated pharmacy technicians and interns demonstrate similar outcomes when compared to pharmacists, there should be more research about the role and efficiency of pharmacy technicians, pharmacy interns, and pharmacy residents. Then, most importantly, future research requires RCTs with large sample sizes. The current literature does not have RCTs with adequate sample sizes such that results that can be generalized. If possible, these RCTs should address confounding factors such as patient adherence, quality of life of patients, then develop a severity scale of diseases for a precise assumption of potential savings. There are many barriers for implementing these RCTs as well as building successful programs or models. First, the study must be done in regards to every disease which is not feasible. Therefore, each hospital or any healthcare setting should set up the priorities on disease control. For example, hospitals can focus on conditions that CMS listed to avoid penalties. Second, the generalizable model requires a large population of demographics as every race holds different characteristics for their treatment. However, it is impossible due to the nature of hospital setting where a patient is admitted and discharged frequently. To address this issue, the study must be done nationally or even internationally with the organizations that can collaborate and hold accreditation by the Joint Commission for example. Also, future studies

should address the association between the socio-economic status of patient and readmission for more specific interventions of pharmacists. Lastly, other than 30-day hospital readmission rate, there should be more performance measuring keys for pharmacists as they involve in the variety of settings such as counseling patient, medication reconciliation discharge medication, phone calls and collaboration with other healthcare providers.

Chapter 6 Practice and Policy Implications

The ACA has opened an unparalleled opportunity for pharmacists in the current healthcare system. Pharmacists are an integral part of health care team through medication reconciliation, ensuring patient education on medication by providing counseling, coordinating a team for patient-centered care has been a key factor for hospitals and ACA itself. However, several studies suggest that the impact of pharmacist-led medication review is not clear. Even with mixed results, pharmacist-led medication reconciliation had significant impact on improving drug-related readmissions, low health literacy patients, and cost containment of unnecessary spending in U.S. healthcare. If involving pharmacists everywhere are not panaceas to reduce all cause hospital readmission, the key would be involving pharmacists effectively. For example, pharmacists seeing patients face-to-face before patients' physicians' appointment decreased readmission rates. Also, Arnold, Buys & Fullas, (2015) found a huge improvement in the effectiveness of pharmacists when pharmacists worked with physicians. Future healthcare requires coordination of care to improve care transition and the study. A change and shift from pay-for-service to the pay-for-performance model will require more and more coordination and communication between healthcare providers.

During the transition, Anderegg et al., (2014) integrated educational opportunities into the process and pharmacy resident and student skill sets were developed and refined. Zemaitis, Morris, Cabie, Abdelghany, & Lee, (2016) expanded the role of pharmacy technicians in medication reconciliation to save time of clinical pharmacist by providing a training program on pharmacy technicians. As technicians are essential in pharmacy and the

study demonstrated the feasibility of incorporating pharmacy technicians in the medication reconciliation process, working as a team would save tremendous time and cost as the effectiveness on readmission did not differ significantly. Also, they found technicians holding retail pharmacy experience were doing better at patient interview as they have done customer service before (Pal, Babbott& Wilkinson, 2013).

In regards to Hospital, target goal of hospital readmission would vary according to their status. Hospitals that have not used pharmacists to lower readmission rate should begin with medication reconciliation program led by pharmacists. However, if pharmacist-led medication reconciliation intervention does not show adequate results, keep pushing it would not help. Since the budget for any hospital is not infinite, finding hospital specific solution would be a key to lower hospital readmission. As seen in previous reviews, those hospitals with many high risk patients (patients taking more than 5 drugs and/or taking problematic drugs depending on diseases) or limited health literacy may focus on treating those patients in order to avoid penalties from CMS.

Conclusion

The ACA established the Hospital Readmission Reduction Program that allows CMS to reduce payments to hospitals that have excess 30-day readmission. Even with mixed results, pharmacist-led medication reconciliation showed cost savings and the fact pharmacists are positioned to provide their expertise on medications to help patients never changes. In response to possible penalties, a hospital may target patients at high risk to reduce readmission rate. More research, especially a RCT with large sample is needed to evaluate cost-effectiveness of pharmacy team and to investigate other risk factors that show clear relationship with hospital readmission.

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Table 1: Overview of identified reviews

Study	Location/ Setting	Study design	Method	Data	Intervention	Outcome
Sebaaly et al. (2015)	Academic Medical Center	Intervention in one Medical Center compared with none in historical cohort patients.	Fisher's exact, chi-square tests and t tests	N= 67	discharge medication reconciliation	30-day readmission rate in the study cohort was 18% compared with 20% in the control group, interventions resulted in \$42,300 in cost avoidance
Anderegg et al. (2014)	Academic Medical Center	Single group intervention base line and follow-up	Student's t test and the chi-square method	N= 3306	Medication reconciliation and patient education activities	the 30-day rate of hospital readmissions declined from 17.8% to 12.3%, possible annual savings of more than \$780,000
Guandi et al. (2015)	St Peter Hospital, Olympia, WA	Single group intervention base line and follow-up	N/A	N= 175	Admission/Discharge medication review and discharge counseling	All HF patients' 30-day readmission rate improved from 17% to 15%, each avoided readmission, there was an associated decrease of \$5652
Arnold, Buys & Fullas (2015)	outpatient primary care teaching clinic	Intervention in clinic compared with none in same clinic	Fisher's Exact Test and 2-tailed Student t-test	N= 334	Medication reconciliation, comprehensive chart reviews, appropriate monitoring of medication therapy	Intervention group had 9.2% or 30-day readmission rate while control was 19.4%
Zemaitis, Morris, Cabie, Abdelghany, & Lee, (2016)	Yale-New Haven Hospital, West Haven, CT	Intervention in the hospital compared with none in same hospital	chi-square analyses	N= 465	Medication reconciliation, counseling and discharge phone calls	pharmacy intervention and the outcomes showed a 27 percent reduction in readmission during the intervention period

Study	Location/Setting	Study design	Method	Data	Intervention	Outcome
Pal, Babbott & Wilkinson (2013)	University of Kansas Hospital, Kansas City, KS	Intervention in 1 hospital compared with none in same hospital	Fisher exact test with mid-P method	N= 729	Medication reconciliation, counseling, teach-back method	The 30-day readmission rate was 16.8 percent among the pharmacy review group vs 26.0 percent among the no-review group
Paquin et al. (2015)	Tertiary care VA Medical Center	Intervention in 1 hospital compared with none in same hospital	chisquare tests, Student t-tests and logistic regression	N= 501	Pharmacist follow-up phone call	every additional 5 minutes of pharmacist-led medication reconciliation on telephone calls was associated with a 15% reduction in 60-day
Li, et al. (2016)	Hospital	Intervention in one Hospital compared with none in historical cohort patients.	Wilcoxon rank-sum test, chi-square test and Fishers exact test	N= 94	Daily medication profile review, counseling, communication of discharge medication	30-day readmission rate was 12.8% in the pilot group vs. 18.8% of participants in historical control
Katelin et al. (2015)	DCH Regional Medical Center, Tuscaloosa, AL	Intervention in one Medical Center compared with none in historical control group	priori decision	N= 108	Medication reconciliation, therapeutic recommendation and follow-up phone calls	30-day readmission rate in the intervention compared to usual care was 27.9% vs. 40.0%
Tedesco et al. (2016)	Primary care physician practice in both Pittsburgh and Uniontown, Pennsylvania	Intervention in 1 physician practice compared with non in control facility	Fischer exact test	N= 62	Medication reconciliation, identified any barriers to treatment, follow-up phone calls	The readmission rate for the intervention group was 14.7%, compared to 26.7% in the control group

Study	Location/Setting	Study design	Method	Data	Intervention	Outcome
Farris et al. (2014)	University of Iowa and Clinics	Randomized Controlled Trial	Chi-square, t-test, standard regression, linear regression and logistic regression	N= 945	Medication reconciliation, patient education, contacting physicians' offices via fax	No statistically significant differences in 30-day readmission rate or ADEs
Briggs et al. (2015)	Emergency Department in New South Wales, Australia	Randomized Controlled Trial	t-tests, χ^2 test, and logistic regression	N= 1021	Review of medication	The odds of admission decreased with the intervention (odds ratio [OR]=0.68)
Bell et al. (2016)	Vanderbilt University Hospital in Nashville, TN and Brigham and Women's Hospital in Boston, MA	Randomized Controlled Trial	multivariable proportional hazards regression	N= 851	Pharmacist-reconciled preadmission medications, discharge medications with the patient, providing tailored counseling	No statistical significance between intervention and control groups on 30 day readmission rate
Renaudin et al. (2016)	N/A	Systematic review	I ² statistic and funnel plots	N= 19 RCTs	N/A	readmission rates did not differ between pharmacist care and usual care group
Parajuli et al. (2017)	N/A	Systematic review	N/A	N= 14 articles	N/A	mixed results for improvement in readmission